which the film can be shifted in the short space of time available for photographic operations. At the last eclipse the photographic work was concentrated on obtaining a series of photographs of the chromosphere both about the time of beginning and end of totality. By careful drill Mr. Fowler and Dr. W. J. S. Lockyer were both able to secure ten photographs at each of these important periods, the time occupied in making each series of ten exposures being 12 seconds. An apparatus for carrying films is also being designed which can be adapted to the spectroscopic cameras at present in use in the laboratory and observatory.—Journal of the Society of Arts.

THE FOREST TENT CATERPILLAR.*

By CLARENCE M. WEED.

DURING the last three years, in many parts of New Hampshire and neighboring States, there has been a serious outbreak of the insect which has long been known as the forest tent caterpillar, although in most regions where it has recently been present it is called the forest worm. It has attacked forest, orchard, and shade trees, and has done a great deal of damage in many regions of New England.

This is no new pest; for a century or more it has been known as a destructive insect. At frequent intervals in the past it has ravaged orchards and woodlands in widely separated States; from Maine to Texas severe attacks by it have been recorded.

These forest tent caterpillars hatch from eggs which are deposited in cylindrical masses that form complete circles upon the smaller twigs of a considerable variety of trees. The appearance of these "caterpillar belts" is shown in Fig. 2; the eggs are covered with a brittle substance which gives the mass a shiny appearance, especially in a bright light.

The young caterpillars or larvæ come forth from the egg in the spring about the time the leaves of the trees begin to unfold. When first hatched they are tiny creatures, scarcely one-tenth of an inch long, showing under a lens that the blackish body is provided with a covering of long brownish or grayish hairs. Wherever they go these little larvæ spin a silken thread which marks their pathway, although the thread is so slender that it is generally to be seen only through a lens.

The tiny caterpillars feed upon the tender leaves of the twig near where the egg mass was placed. In about two weeks each larva increases in size to such an extent that the skin in which it came from the egg is too small for it. This skin then splits open along the back, and the caterpillar crawls out clad in a new skin that had gradually been forming beneath the old one. This skin-shedding process is called moulting; it is the general way in which insects provide for increase in size. All sorts of caterpillars as well as other insects moult as they grow.

After the first moult the forest caterpillars begin feeding again, eating of course more and more of the foliage as they become larger. A week or so later they again moult, a process which is twice repeated thereafter at similar intervals. At the period of moulting the caterpillars are in the habit of congregating upon the trunks or larger limbs of the tree, often not far from the ground. Beneath the mass of larvæ there is an inconspicuous web in which the feet are more or less entangled. The appearance of the caterpillars at such times is well shown in the photograph reproduced in Fig. 3, for the use of which I am indebted to Dr. F. W. Russell, Winchendon, Mass.

When the caterpillars become full grown in this, their larval state, each seeks a place in which to spin

FIG. 1.—THE FOREST TENT CATERPILLAR.

its cocoon. Many remain in the trees and tie up the leaves by silken threads, thus forming a partial or complete covering for the cocoon (Fig. 4). Others seek crevices in the rough bark, while many others—probably one-half or more of all the caterpillars—forsake the tree and wander off in all directions, utilizing any shelter they may come upon. They commonly crawl up the sides of houses and other buildings, and form their cocoons along the clapboards or beneath the gables.

The cocoon is made of silk with an outer mass very loosely spun, and an inner mass so much more closely woven that it forms a web of almost parchment-like texture. As in the case of the American tent caterpillar, the threads of the cocoon are white when first spun, but become yellow by being saturated with a liquid which the caterpillar ejects shortly before pupation. As this liquid dries it leaves a yellow powder in the silk.

Soon after forming the cocoon around itself the caterpillar changes to the pupa or chrysalis condition, becoming an oval brown object without legs or wings, able to move only by a wriggling of its body. In this condition it takes no food, but within the quiet exterior the body of the caterpillar is being developed into that of a moth.

About ten days after the cocoon was made the pupa skin cracks open, and a brownish moth emerges from

FIG. 2.—EGG MASSES.

the cocoon; this is the adult condition of the forest caterpillar. The male moths are slightly smaller than the females.

The moths generally make their appearance the latter part of June. Soon afterward the females deposit their eggs in masses of about two hundred each upon the twigs. The moths, having completed the cycle of life, die soon after the eggs are laid.

The eggs thus deposited early in July are to remain unhatched until the following spring. The actual formation of the tiny caterpillars from the contents of the egg takes place, however, within a few weeks after they are laid. The minute but fully-formed caterpillars may be found within the egg shells, by a careful examination, any time between September and the following April. The caterpillars remain during this long period quietly confined within their narrow houses, but when the warm rays of the spring sunshine penetrate their abodes, they eat off the tops of the egg shells, and come out ready to break their long fast upon the tender foliage of the unfolding buds.

HABITS OF THE CATERPILLARS.

The caterpillars very commonly emerge from the eggs some time before the leaves of their food-plants push out. Under such conditions the tiny larvæ are likely to huddle together upon or near the egg mass to await the unfolding of the leaves. There seems to be considerable variation in the time of hatching, as larvæ of various sizes may be found at any time during the latter part of May or in June.

When the attack is not severe, the caterpillars seem to keep to the upper parts of the tree, especially upon the ends of the outer branches.

In this instance the damage had evidently been done before the presence of the insect was known. Consequently, it seems worth while for the owners of maple or other groves to keep a sharp watch upon their trees this season, even if heretofore they have not been injured.

When the caterpillars are disturbed while feeding upon the leaves or crawling along the twigs they have a habit of dropping downward, checking the fall by means of a thread spun from the mouth and attached to the twig. Thus suspended in mid-air they are very annoying to foot passengers in villages or to people riding along shaded roads in town or country; for to find yourself suddenly confronted by a dozen caterpillars on the level of your face is disconcerting.

According to some observations made by my assistant, Mr. W. F. Fiske, to whom I am indebted for a number of observations upon this insect, the young caterpillars if suddenly disturbed while feeding will drop to the ground without attaching their threads. A large proportion of the caterpillars drop off by means of a thread at one time or another during their growth; some are probably startled by the swaying of the twig in the wind; others by birds when alighting; in many cases the movement is probably induced by the exhaustion of the food supply, or, perhaps, by a migratory instinct. In any event, this dropping is very general, and as a result the caterpillars are continually to be seen crawling up the trunks of the trees. This is especially likely to be the case early in the morning.

The larvæ generally crawl along the limbs in single file. As they go, each spins from its mouth a delicate silken thread. When not eating, they congregate in masses upon the larger limbs, with an indistinct web beneath them, although generally there is no web over them, as is the case with the American tent caterpillar.

In feeding, especially as they approach maturity, the caterpillars commonly eat through the leaf in such a way that the outer end drops to the ground. The result is that in the case of the badly-infested trees the ground beneath is covered with these leaf fragments, which may be heard falling continually as the caterpillars work. This habit causes the insect to be relatively much more destructive than if it simply devoured the whole leaf because the tree is robbed of more of its leaf-surface, the damage done being somewhat analogous to that of the cutworms, which eat off the stem of a corn plant without devouring the leaves.

During the moulting periods, as well as during long-continued storms, the caterpillars collect together in great masses, resting upon a silken web attached to the bark of the tree. (Fig. 3.) Here they remain a day or two, until the old skins are sloughed off and the new ones are ready for use.

The caterpillar of this species is at once distinguished from the common American tent caterpillar by the differences in the markings of the line along the middle of the back. In the forest tent caterpillar this line is interrupted, consisting of a series of white markings, while in the common tent caterpillar the line along the middle of the back is continuous.

The two species of caterpillars may frequently be found intermingled. Sometimes a brood of the forest species will collect upon the outside of the tent of the common species.

When an orchard or grove in which the caterpillars have developed is defoliated, they will migrate to neighboring trees in a way suggestive of the migrations of the army worm.

At such times they may be seen in incredible numbers. Several cases are on record where in crossing railway tracks they have impeded the progress of trains by making the rails slippery as the bodies were crushed.

Those forest caterpillars which utilize leaves in forming their cocoons seem to have very little choice as to the leaves employed.

Evidently the larvæ utilize whatever foliage they find available when the stress of cocoon making is upon them. A correspondent at Haverhill, New Hampshire, reported that she found "pine trees covered with the cocoons of the forest tent caterpillar. The needles were tied together with their silk, and the cocoons inside of them." These leaf coverings are of all degrees of perfection, from such a well-knit specimen as shown in Fig. 4 to that of a cocoon in which two or three grass blades serve little more purpose than that of supporting the silken woof of the cocoon. Two or more cocoons are commonly spun within a single leaf, and trees frequently appear "bunched up" from the action of the caterpillars. Numerous observations indicate that normally about as many caterpillars spin cocoons in leaves as out, but the proportion would be likely to vary with the conditions present in a given locality.

HABITS OF THE MOTHS.

Like most moths the adults of these forest caterpillars are night-fliers rather than day-fliers. They are attracted by light after dark, and frequently fly through open windows into houses. Late in the afternoon they may also be seen, when abundant, flying among the branches of the trees.

ABUNDANCE AND INJURIES.

The injuries caused by these caterpillars have been serious and widespread. In many regions they have defoliated the maples of sugar groves. In some cases the trees have been killed, while in others their vitality has

FIG. 3.—A MASS OF CATERPILLARS ON THE TRUNK OF A CRAB-APPLE.

(Photographed by Dr. F. W. Russell.)

been so weakened that they became, at least temporarily, of little value for sugar production. When sirup is made from such trees, it is of such inferior quality that it is often locally called "buggy sirup." All through the infested regions hillsides may be seen in which the woods are brown and bare from the attacks of the caterpillars. It is difficult for one who has not seen an outbreak of such a pest as the forest caterpillar to get an adequate conception of the enormous numbers which may be present. They have been collected, quarts at a time, in many localities, and are often so

* Bulletin No. 64, New Hampshire College Agricultural Experiment Station, Durham. Reproduced by permission.

abundant on the trunks of trees as to conceal the bark from view.

The effect of a sudden onslaught of an army of these caterpillars migrating from a neighboring woodland to an apple orchard may be disastrous. Defoliation may take place in so short a time that the leaves are gone before the presence of the caterpillars is known. In many cases a new crop of leaves will be put out, but the vitality of the trees is necessarily impaired.

DATES OF TRANSFORMATIONS.

The statement has already been made that there is considerable variation in the time of hatching of the caterpillars. By the middle of June, when some of the larvæ had become full-grown and spun cocoons, others had only moulted once, and many others only twice. The majority of the caterpillars spun up by June 25, and practically all by the 30th of the same month. Many of these caterpillars which spun latest were much smaller than the normal size. The earliest moths emerged about June 24.

NATURAL ENEMIES.

These forest tent caterpillars are preyed upon by many natural enemies, including insects, spiders, toads, and birds. Among the more important insect enemies are certain ichneumon flies, which deposit eggs within the bodies of the caterpillars. These eggs hatch into grubs that develop at the expense of the caterpillars, finally killing them. There are various other insect enemies.

A curious habit of a common species of harvest spi-

FIG. 4.—COCOON OF FOREST TENT CATERPILLAR IN A MAPLE LEAF. Natural size.

der or daddy-long-legs was observed by Miss Soule. On June 18 she wrote: "On almost every mat of Clisiocampa larvæ we find several 'daddy-long-legs,' sometimes as many as twenty. I have watched them closely and can see no reason for their being there." A week later she wrote again: "It seems this morning as if almost every larva was attended by a 'harvester,' which apparently stroked it with a leg or two or merely stood near or over it. Sometimes the touch made the larva curl up, but more often it seemed to have no effect. It is very curious, and I watch and watch, but can learn nothing." The species concerned seemed to be the common striped harvest spider,* as I judged from some half-grown specimens sent by Miss Soule. As to the reason for their presence, I can only conjecture that they found food in connection with the caterpillars in some way.

Toads were seen to devour many of the caterpillars, although, of course, these creatures are comparatively so rare that they could make little impression upon the pests.

Birds, however, did a great deal toward reducing the

FIG. 5.—THE CHIPPING SPARROW.

numbers of the insects. Miss Soule observed robins, orioles, chipping sparrows, cat birds, cuckoos, the red-eyed, white-eyed, and warbling vireos, cedar birds, and nuthatches, feeding upon the caterpillars. The nuthatches, according to Miss Soule's account, "would stand by a patch of larvæ lying close together below a tar band on a tree and eat so voraciously and with such an entire abandonment of self-consciousness that I could go close and put my hand on them before they would fly. This experience was repeated several times." The cocoons were attacked by chickadees, which tore open the cocoons and fed upon the pupæ, as well as by nuthatches. The moths were also eaten in great numbers by many sorts of birds, including robins, chipping sparrows, yellow birds, and even English sparrows, although this last named species apparently did not eat the caterpillars.

In some localities the forest tent caterpillars were attacked by what appeared to be a bacterial disease similar to the one which destroyed so many of the American tent caterpillars in southern New Hampshire in the summer of 1898. (See Bulletin 59, p. 202.) It is to be hoped that the present season it may complete its work, for this is probably the agency that is most likely to check the outbreak. Its destructive effect is likely to be increased by weakness in the caterpillars, due to the partial exhaustion of the food supply. There was also evidence that a fungus disease called "muscardine" was at work among them.

* Litbunum dorsatum.

REMEDIAL MEASURES.

Many remedial measures have been proposed at various times to prevent the injuries of the forest tent caterpillar. The practical value of most of these measures depends largely upon the conditions under which they are to be applied. A suggestion that is easily applicable to a few small trees in an apple orchard may be wholly inapplicable to the large trees in a woodland.

The abundance of the caterpillars, the nature and number of the trees infested, the season of the year, and the means at hand are all to be taken into consideration. In the following paragraphs I have summarized the measures which a careful study of the subject leads me to think will prove of value. They are arranged according to stage of growth—from egg to moth—to which they are to be applied.

Egg Destruction.—On a bright day, when the trees are bare of leaves, the egg masses may be easily seen. The cutting off and burning of these masses is often practicable in a young apple orchard, although it is generally considered impracticable in orchards of large trees. It generally would be out of the question in woodlands, of course, although in case of a few ornamental maples or other trees on the home grounds such egg collecting might well be worth while. The gathering may be done by sending a sharp-eyed boy into the trees to cut off the glistening masses, or by means of a pruning hook or a pair of long-handled pruning shears. The belts of eggs should be burned after they are gathered.

Killing the Young Caterpillars.—On small trees, where the caterpillars are easily reached, something may be accomplished by swabbing the colonies of young larvæ when at rest by means of a bunch of cotton waste, old rags, or something similar. In rainy weather one is more likely to find the larvæ massed together during the day than in bright weather.

Spraying with Poisons.—For the apple orchards, so far as concerns the caterpillars which hatch there, perhaps the simplest way of destroying these pests is to spray the trees with arsenites early in the season before the caterpillars are half grown. After the leaves are unfolded and the caterpillars have begun work, the earlier this spraying is done the better, except that it should not take place when the trees are in bloom. The common practice in spraying is to add four or five ounces of Paris green and a pint or two of fresh lime water—made by slaking lime in water—to a barrel holding forty or fifty gallons of water. This is thoroughly mixed and sprayed upon the trees by means of a force pump and spray nozzle. In Fig. 6 a simple and effective spraying outfit is represented. It consists of a kerosene barrel holding fifty gallons, a force pump having a double discharge, with a short line of hose running into the barrel to keep the liquid stirred, and a long line of hose fitted at the end to a slender brass rod tipped with a spray nozzle. This outfit, or a great variety of similar ones, may be obtained through any hardware dealer or direct from any of the numerous manufacturers of spraying machinery.

In case it is desired to spray trees of many sorts, it would probably be safer to use arsenate of lead, which is less liable to injure foliage than Paris green. This substance has been used in great quantities by the Massachusetts Gypsy Moth Commission. It has been found a safe insecticide for all sorts of trees. It is not generally on sale in the market, but can be made according to the following directions of Prof. C. H. Fernald:

"Arsenate of lead is easily prepared by putting 11 ounces of acetate of lead in 4 quarts of water in a wooden (not metal) pail and 4 ounces of arsenate of soda (50 per cent.) in 2 quarts of water in another wooden pail, and, when entirely dissolved, mixing them in a hogshead containing 150 gallons of water, when a chemical reaction will take place, forming arsenate of lead as a fine white powder in suspension in the water. If cold water be used in the wooden pails, the solution of the acetate of lead will require a little time; but, however, if the water be hot, it will dissolve very quickly. It is customary to add from 2 to 4 quarts of glucose to the above amount of water. If it is desired to use larger proportions of the arsenate of lead, it is only necessary to use more acetate of lead and arsenate of soda, but in the proportions given above."

Another substance which has lately been put upon the market as a substitute for Paris green is called green arsenite. It is a finer powder than Paris green and generally costs at retail 15 cents a pound. It can be purchased of dealers generally, or direct of the manufacturers, the Adler Color and Chemical Company, New York. One great advantage it has over Paris green is that being a finer powder it remains in suspension much longer. A little lime water should be added to the mixture as in the case of Paris green. It is to be used at the rate of four or five ounces to fifty gallons of water.

Killing the Older Caterpillars.—After the caterpillars are half grown they commonly come down to the lower branches or the trunk to undergo the moulting process. To this end they gather in great masses on the bark, where they may be destroyed by means of a stiff broom—more effective, perhaps, if frequently dipped in kerosene—or by collecting the caterpillars in pails containing a little kerosene and water. In the towns and villages throughout the infested regions vast numbers of the pests were destroyed in these ways, especially the latter, in 1898.

Banding.—The fact that so large a proportion of the caterpillars drop off the trees from time to time and return by crawling up the trunks has led to the quite general use of bands of various materials upon the trunk to prevent the ascent of the larvæ. Tar has been quite generally applied for this purpose, but it is objectionable, as it does not remain effective long, so that the caterpillars are soon able to cross over it. Sticky fly-paper—"Tanglefoot"—has been commonly used with a large degree of success; it is effective, cheap, and easily applied. Rather wide bands of it are necessary to prevent bridging over by the dead or dying caterpillars. The chief difficulty with this paper is its liability to injury by rain, the wetness causing it to tear so readily that it may not last long. In some cases bands of greased tin have been successfully employed.

A better substance than any of these, however, is Raupenleim, or "caterpillar lime," a material manufactured in Germany for application to the bark of trees to prevent the ascent of caterpillars and other crawling insects. It is to be put on as a rather wide band, or as two narrower bands. In the case of large trees with thick bark the material may be smeared directly upon the bark, while in the case of young trees and those with smooth bark it is safer to apply the Raupenleim by smearing it upon a band of heavy wrapping paper or some other thick and firm paper tacked upon the tree. Any loose bark may be scraped off the portion of the trunk which is to be covered by the paper before the latter is put on; and it is sometimes worth while to insert a thin layer of cotton waste, or some similar material, beneath the paper to fill up crevices and thus prevent any insect from crawling through beneath the paper. Then the Raupenleim may be smeared upon the paper the thickness of about a quarter of an inch, and left as long as it remains sufficiently sticky to entrap any insect that attempts to crawl over it. As it will remain eight or ten weeks in a sticky condition, a single application early in the season will probably last until danger from the caterpillars is past.

It should be distinctly understood that there may be danger of injuring trees with smooth and thin bark if this Raupenleim is smeared directly upon the bark. For young trees and those older which have a smooth bark I recommend that the Raupenleim be applied by placing it upon strips of thick paper tacked to the trunks of the trees. Even in the case of bearing apple trees this would probably be the safer method, and it should always be adopted for peach trees if not for pear trees also. After the Raupenleim has been on

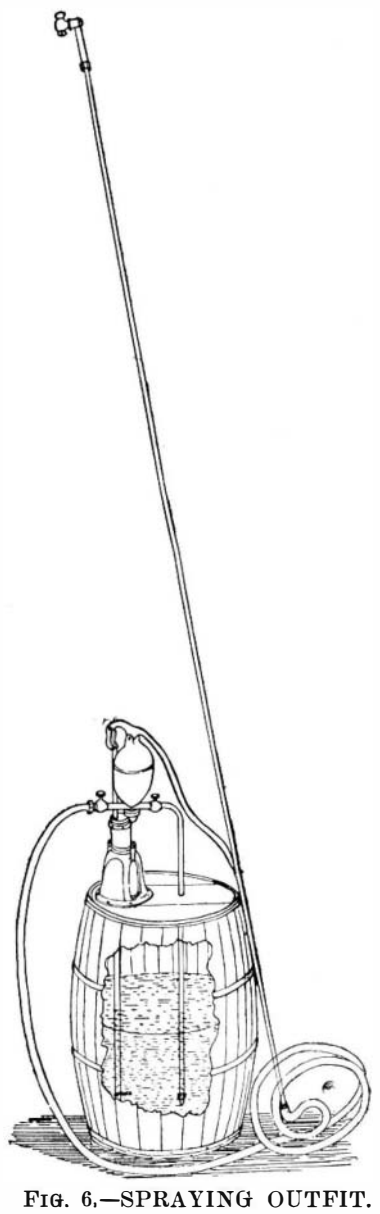


FIG. 6.—SPRAYING OUTFIT.

some weeks the surface hardens into a crust, and it is advisable to scrape off this crust after the danger from caterpillars is past. Too much of the rough bark should not be scraped off of the older trees to which the band of Raupenleim is to be applied, unless paper is to be used.

After the trees are thus banded, the caterpillars will collect beneath the bands, and, of course, are to be killed by means of a stiff broom, or any other method one may choose.

The American distributers of Raupenleim are William Menzel & Company, 64 Broad Street, New York, N. Y. In New England it can be purchased through the Bowker Fertilizer Company, Boston, Mass., and probably other dealers. It is put up in five pound cans, costing about $1 per can; or in kegs holding twenty-five pounds, costing $3.75 per keg. Larger kegs are proportionately cheaper.

Jarring and Banding.—It has already been stated that these caterpillars drop downward when disturbed, breaking the fall by means of a thread spun from the mouth; although when young and suddenly jarred apparently the thread may not be used. This habit leads to the suggestion that by a combination of jarring and banding much injury may be prevented, at least in the apple orchard and on the home grounds. After the trees infested have been banded with the caterpillar lime, a boy with a padded mallet may be sent into them with instructions to jar the limbs on which the caterpillars are working, beginning at the top. This should be done when the caterpillars are feeding upon the leaves as they are then much more easily disturbed than when they are at rest. Of course it is not to be expected that going over once will wholly rid the tree,

but by two or three repetitions of the jarring most of the caterpillars should be removed. In case they hang too persistently by their threads, many of them may be swept out of the air by use of a long, light pole. This will lead the caterpillars to congregate in masses upon the trunk below the bands of Raupenleim, where they may be destroyed by use of a stiff broom or by various other methods. The earlier this is done after the larvæ are all hatched, the less will be the injury to the foliage.

The masses of caterpillars beneath the bands are sometimes killed by pouring on kerosene. If this method is employed, great care should be taken not to add enough to saturate the bark. Many trees have been killed by carelessness in such use of kerosene.

Banding to Prevent Invasion.—In case of an uninfested apple orchard in the vicinity of an infested woodland, it will be advisable to band the apple trees with Raupenleim before the caterpillars are half grown to prevent invasion from them.

The same advice would hold in case of other uninfested trees in the vicinity of those infested.

Collecting Cocoons.—A large proportion of the cocoons are commonly spun where they can be reached. The destruction of these will lessen the number of moths that lay eggs for the next season's brood of caterpillars, although it will also lead to the destruction of large numbers of parasites. If the cocoons were placed in a good sized box with coarse-meshed mosquito netting over it, the escape of the moths might be prevented while the parasites might get away to continue their good work. By a little trouble the moths remaining in the box could be killed.

Attracting Moths to Light.—Like many other night-flying insects the moths of the forest tent caterpillar are attracted to lights at night. This has led to the suggestion that they may be destroyed by placing a lighted lantern over a tub or other wide vessel containing water with a film of kerosene on top. The moths fluttering about the light will fall into the kerosene and be killed. Such destruction will lessen the number of eggs for next year's brood of caterpillars.

PLAN FOR THE WIDENING OF NEW YORK EAST SIDE STREETS.

By N. J. VANDER WEYDE, Civil Engineer.

THE accompanying map contains a plan for widening and extending certain streets and avenues south of Fourteenth Street and east of Broadway, and represents a life-long study on the part of its designer of the need of more and better avenues of transportation in New York. Intimately familiar with the streets of the metropolis from boyhood, he has appreciated the advantages of the few street openings that have been made in his time in the lower part of the city; notably New Bowery, Church Street and Trinity Place, New Chambers, South Fifth Avenue (now West Broadway), College Place (ditto), and very recently the widening of West Street north of West Eleventh, and Elm Street, which is nearing completion, but yet remains to be appreciated.

It will be readily confessed that both travel and traffic between different sections of lower Manhattan need better facilities in regard to space to move about in, and that certain highways and byways, now almost dead to trade, need straightening and widening in the general interests of business prosperity. Above Fourteenth Street the street and avenue system seems symmetrical enough for all practical purposes, but below that line it becomes more and more chaotic as we proceed toward the lower portion of the city, where narrow and crooked streets are not only a bane to trade but too often the hotbeds of crime.

When the new East River Bridge is finally completed, its westerly end will terminate at Clinton Street, just south of Delancey, as indicated in the map, in the center of the district east of Broadway between Fourteenth Street and the Brooklyn Bridge. An imposing front and approach is promised, and a plaza covering a space of two blocks west of Clinton Street has been decided upon. A vast amount of traffic and travel will be certain to gravitate here. Consequently, it is here that the street widening scheme finds its first opening and its most important field of operations.

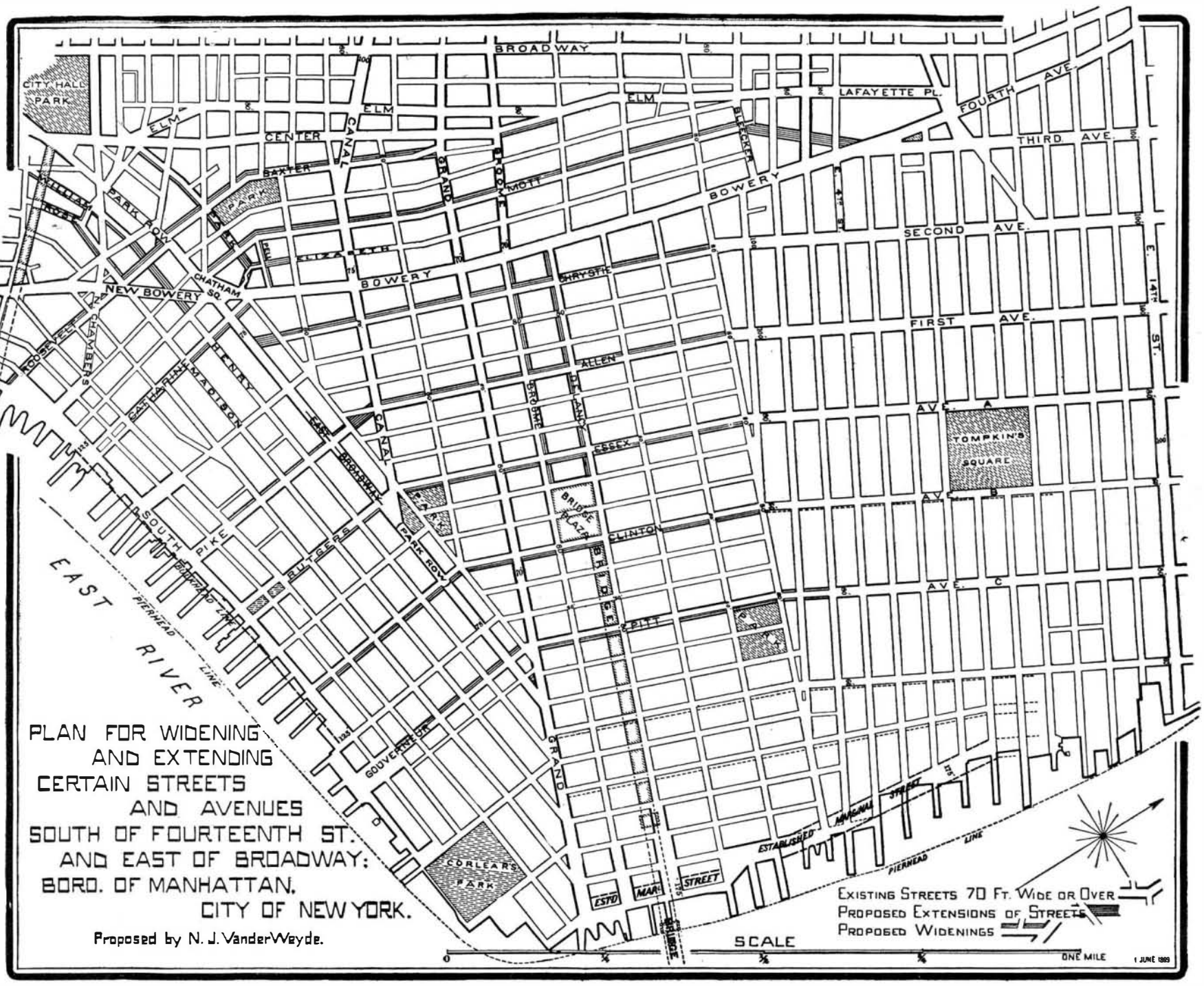
To begin with, Broome and Delancey Streets are to be widened under this proposed plan to eighty feet or more from the Bowery to both sides of the bridge plaza; this will give full facilities to elevated and surface railways, as well as to ordinary street traffic. The London and Paris system of having one street for up travel and the other for down is most advisable for adoption here. Certain north and south streets, east of the Bowery, should be widened to give better facilities to the traffic of the avenues north of Houston Street. These are Chrystie, Allen, Essex, Clinton, and Pitt, the good work to be continued below Division by widening Catherine, Pike, Rutgers, Clinton, and Gouverneur Streets to the river.

East Broadway (which is a direct continuation of and should be renamed Park Row), Canal Street and Grand Street seem to be wide enough, but Park Row east of Chambers (once the famous Chatham Street) is too miserably narrow for the traffic it carries. It is like the neck of an hour glass, there being no other ready way of getting from the Bowery to City Hall, the Bridge, or the Post Office. Property values are high on old Chatham Street and there certainly is considerable prejudice against any radical measures in this quarter, but upper William and Rose Streets might be extended and widened to meet Henry and Madison and give some relief to Park Row on the south side.

The Elm Street widening has been carefully plotted on this map; it only remains for Marion Street, north of Broome, to be widened one block to give Center Street adequate connection therewith. Baxter and Roosevelt Streets should be widened as well as Mott Street; the upper end of the latter to be extended through four blocks to the head of the Bowery, offering direct facilities to traffic on Third and Fourth Avenues and relieving excess of travel on the Bowery as far as Chatham Square.

Elizabeth Street is but a narrow affair and offers no special inducements for widening, but in order to clean out Chinatown, it is proposed to extend this street one block southerly into Pell Street, to widen the latter to eighty feet, to widen and straighten Doyer Street so as to leave but one angle in it, and then to cut Park Street through from Mott Street, forming a Y in the triangular block north of Chatham Square. Park Street might then be advantageously widened as an additional relief to Park Row.

A continuous marginal street along the East River is still a dream of the future, many engineering difficulties presenting themselves which are not encountered on the North River water front (see No. 1218 SCIENTIFIC AMERICAN SUPPLEMENT); but it will no doubt be realized in the near future, as commerce is seriously handicapped for the want of it. In regard to West Street, the writer proposes an elevated freight railway having direct connections with the Hudson River Railroad and the Western railways coming over the projected Hudson River Bridge and having spurs on the various steamship piers, where overhead loading and unloading could be carried on direct with the holds of the vessels without interfering with the use of the main decks of the piers. This would offer facilities to the shipping trade unequaled in any other seaport in the world.



Attracting Moths to Light.—Like many other night-flying insects the moths of the forest tent caterpillar are attracted to lights at night. This has led to the suggestion that they may be destroyed by placing a lighted lantern over a tub or other wide vessel containing water with a film of kerosene on top. The moths fluttering about the light will fall into the kerosene and be killed. Such destruction will lessen the number of eggs for next year's brood of caterpillars.

COMPARATIVE COSTS OF CABLE, ELECTRIC, AND HORSE TRACTION IN NEW YORK.

THIS article, for the first time in the history of street railroading, gives a true comparison of the relative cost of operation of cable, electric, and horse railways in a single city and under substantially the same conditions by a company controlling the local transportation of over 250,000,000 passengers per annum. On broad principles the company's experience points unmistakably to the great superiority of electricity over both horses and cable, not only in traffic handling capacity, but in economy.

On January 1, 1893, the entire street railway system of New York city was operated by horses. The importance of doing away with horse traction, in the in-